OPERATING INSTRUCTIONS 8-52 874-FR

TYPE 874-FR REJECTION FILTER
for
MEASURING HARMONIC CONTENT
of
T-V TRANSMITTER OUTPUT

. . . . SINCE 1915
manufacturers of
electronic apparatus
for science and industry

GENERAL RADIO COMPANY
CAMBRIDGE 39, MASSACHUSETTS, USA

OPERATING AND MAINTENANCE INSTRUCTIONS

TYPE 874-FR REJECTION FILTER for MEASURING HARMONIC CONTENT of T-V TRANSMITTER OUTPUT

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GENERAL RADIO COMPANY

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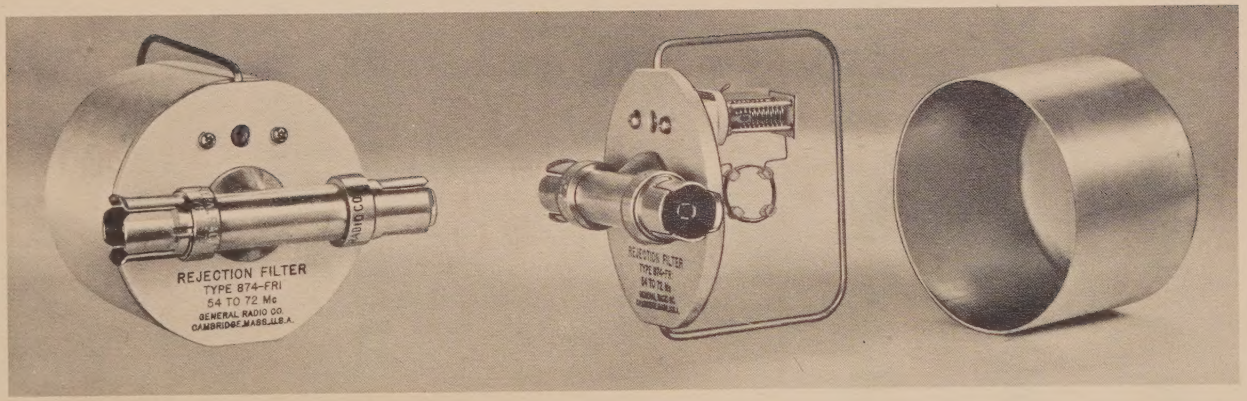

Figure 1. Type 874-FR1 Rejection Filter.

TYPE 874-FR REJECTION FILTER

Section 1
INTRODUCTION

1.1 GENERAL. The harmonic content of a television transmitter (or other signal source) can be measured by the application of a sample of the output signal to a tunable, selective detector whose sensitivity is independent of frequency. The detector is tuned first to the fundamental and then to each of the harmonics of interest, whose relative signal strengths are determined.

One source of error, very important in measurements of small harmonic contents, is the generation of harmonics in the nonlinear detector by the large fundamental signal. To eliminate this error, the circuits ahead of the detector must greatly attenuate the fundamental signal when the harmonics are being measured.

The detector used must be linear over very large input ranges, and the over-all frequency response of the selective circuits and detector must be flat over the frequency range of the harmonics of interest. The Federal Communications Commission requires that all harmonics up to the tenth that are below 1000 Mc be at least 60 db below the fundamental level.

1.2 CIRCUIT. The system for measurements of harmonic content up to about 100 db comprises a Type DNT Detector, appropriate Type 874-FR Rejection Filters, Types 874-G10 and 874-G20[1] Pads, and a suitable Type 874-F Low-Pass Filter. (See Figure 2.) The pads are used to obtain the 50-ohm impedance level for which the whole circuit is designed.

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[1]The older Type 874-GG or -GF Pads can be substituted for the Type 874-G10 or -G20 Pads.

The equipment required for measurements on various channels is tabularized below.

CHANNEL	DETECTOR	REJECTION FILTER	PAD	LOW-PASS FILTER	UNIT OSCILLATOR	RECOMMENDED ACCESSORIES
2 thru 4	DNT-1*	874-FR1 (two)	874-G10 (two) 874-G20	874-F1000 874-F185	1209	874-Y (five)
5 and 6	DNT-1*	874-FR2 (two)	874-G10 (two) 874-G20	874-F1000 874-F185	1209	874-Y (five)
7 thru 13	DNT-1*	874-FR3 (two)	874-G10 (two) 874-G20	874-F1000	(1209†)	874-Y (five)

*The Type DNT-1 Detector assembly consists of the following:

Type 1216-A Unit I-F Amplifier, Type 874-MR Mixer, Type 874-F500 Low-Pass Filter, Type 1208 Unit Oscillator, Type 874-EL 90° Ell, and Type 874-G10 Pad. The oscillator and filter included in the detector assembly are required in addition to the units specified in the above chart.

†For most convenient operation, a Type 1209 Unit Oscillator is recommended to minimize possible confusion with spurious response.

Section 2

PRINCIPLES OF OPERATION

2.1 FUNDAMENTAL REJECTION FILTERS. A Type 874-FR Rejection Filter (Figure 1) consists of a series resonant circuit connected across the coaxial line and tuned to the fundamental frequency. Each filter provides an insertion loss of from 30 to 40 db, depending on frequency, and practically zero insertion loss at frequencies up to at least the tenth harmonic of the fundamental or 1000 Mc, whichever is lower. Three different filters are provided to cover the frequency range of V-H-F T-V transmitters. The ranges and channels of these filters are as follows:

Filter Type No.	Frequency Range	Channel
874-FR-1	54 to 72 Mc	2, 3, 4
874-FR-2	76 to 88 Mc	5, 6
874-FR-3	130 to 216 Mc	7 thru 13

These filters will tune over much wider frequency ranges than those specified above, but at frequencies outside these ranges they will not neces-

sarily have flat frequency responses up to the tenth harmonic. To obtain the desired rejection of from 60 to 80 db, two filters are used, with a Type 874-G10 10-db Pad connected between them.

Actual tuning ranges of filters are:

Type 874-FR-1	54 to 90 Mc, flat to at least 740 Mc
Type 874-FR-2	76 to 135 Mc, flat to at least 900 Mc
Type 874-FR-3	130 to 216 Mc, flat to at least 1300 Mc

2.2 DETECTOR. The Type DNT Detector Assembly consists of a Type 874-MR Mixer Rectifier, a Type 1216-A I-F Amplifier, a Unit Oscillator, a Type 874-G10 Pad, and a Type 874-F Low-Pass Filter. The signal from the oscillator is mixed, in the mixer rectifier, with the incoming signal to be measured, and the oscillator frequency is adjusted to produce a 30-Mc difference frequency signal, which is amplified by the i-f amplifier. The amplifier is provided with a calibrated output meter (0 to 10 db) and a calibrated step attenuator with a range of 70 db; hence the difference in signal levels up to about 80 db can be determined from the amplifier alone. Harmonic signals with magnitudes over 100 db can be measured by means of additional Type 874-G20 20-db Pads inserted in the detector input when the harmonic level is determined. The mixer itself is very linear over the whole range of the attenuator in the i-f amplifier if the local oscillator level is kept sufficiently high; that is, above an indication of about 20 divisions of rectified mixer current.

2.3 FREQUENCY RESPONSE. The over-all response of the complete system, consisting of pads, filters, and mixer rectifier, is shown in Figures 2 and 3. The small peaks in the response curve are caused by the shunting effect of the local-oscillator circuit on the crystal mixer. A series 250-ohm resistor is built into the local-oscillator arm in the mixer rectifier to keep the response variations reasonably small and yet not reduce the local-oscillator voltage applied to the crystal too greatly. As indicated, the over-all response is flat within a few db over a frequency range at least 10 times the fundamental frequency or to 1000 Mc, whichever is the lower.

2.4 OSCILLATOR FREQUENCY RANGE. The fundamental frequency range of the Type 1208 Unit Oscillator (supplied with the Type DNT-1 Detector) is from 65 to 500 Mc. Harmonics above 530 Mc are measured by beating them against the second harmonic of the local-oscillator signal.[2] The mixing efficiency at the second harmonic is not dependent on the harmonic content of the local-oscillator signal applied to the mixer, since harmonic operation is mainly dependent on the nonlinear charac-

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[2]The 250- to 920-Mc range of the Type 1209 Unit Oscillator permits measurements on the fundamental of the local oscillator at the higher-frequency signal harmonics.

teristic of the mixer itself. When the second harmonic of the local oscillator is used, the mixing efficiency is about 3 db less than it is when the fundamental is used, if the local-oscillator voltage applied to the mixer is large enough (usually over 20 divisions of rectified mixer current on the meter of the i-f amplifier). For a more accurate check, one signal harmonic in the vicinity of 400 Mc can be measured twice, by the use of both fundamental and second-harmonic mixer operation.

A Type DNT-2 Detector, which includes a Type 1215 Unit Oscillator having a fundamental frequency range of 50 to 250 Mc, can be used in place of the Type DNT-1 Detector if a Type 1209 Unit Oscillator is also provided for frequencies above 250 Mc.

2.5 SPURIOUS RESPONSES. Since all harmonics are applied simultaneously to the detector, numerous responses will be obtained when the oscillator is tuned over its frequency range. Responses will be obtained whenever the difference between a harmonic of the local-oscillator frequency and a harmonic of the signal frequency is equal to 30 Mc. The correct responses can usually be identified if the local oscillator is set to the response closest to 30 Mc above or below the frequency of the harmonic to be measured. In second-harmonic mixer operation, the local oscillator should be set to the response closest to 15 Mc above or below half the frequency of the desired signal harmonic (which is a 30-Mc spacing between the second harmonic of the local oscillator and the desired signal harmonic). The greatest difficulty is encountered when the signal frequency is close to a multiple of 60 Mc. For convenience, a chart showing local-oscillator settings and the location of the nearest possible spurious responses for each channel is provided at the end of these instructions.

Most of the undesired responses can be eliminated by the insertion of a low-pass filter ahead of the detector as shown in Figure 4. These filters provide good coverage. Use the following Low-Pass Filters for the frequencies indicated:

Frequency	Low-Pass Filter Type No.
below 185 Mc	874-F185
185 - 500 Mc	874-F500
500 - 1000 Mc	874-F1000

The insertion loss in the pass bands of these filters varies between zero and 4 db. Corrections can easily be made for these variations. The magnitude of the correction for each channel is listed in the charts at the end of the book.

As previously noted, the greatest difficulty occurs when the signal frequency is near 60 Mc. In this instance, when the local oscillator is tuned 30 Mc above the fundamental or a particular harmonic, it is at the

same time 30 Mc below the next higher harmonic. Therefore, both responses will be detected at the same time. If the signal frequency is near, but not exactly 60 Mc (e.g. the aural carrier on Channel 2, at 59.75 Mc), the resolving power of the i-f amplifier is not great enough to separate the two responses, and the meter will indicate the stronger harmonic. For practical purposes, since the only interest is in proving that the harmonics are below a certain level, the fact that there is an uncertainty concerning the number of harmonics being measured is unimportant.

If the signal frequency is far enough removed from 60 Mc to permit the i-f amplifier to resolve the two signals (e.g. the visual carrier on Channel 3, at 61.25 Mc), two closely spaced responses will be obtained. If the local oscillator is set for this channel at a frequency above the signal or harmonic frequency, the desired response is the lower of the two observed. The higher response is the next higher harmonic. (See Charts.)

2.6 COUPLING TO MAIN TRANSMISSION LINE. Harmonics in the transmitter output can be measured either with the line terminated in a dummy load that has a reasonably low VSWR at the highest harmonic frequency of interest, or with the line connected directly to the antenna. When the line is connected directly to the antenna, the antenna is usually a very poor match at the harmonic frequencies. The reflections are large, and relatively large harmonic standing waves can be set up on the line, and hence large variations in results can be obtained by couplings at different points on the line. If a directional coupler[3] is used as the coupling device between the line and the detector, and is set up to measure the forward wave, the harmonic content of the signal traveling toward the antenna can be measured and the same answers obtained at any point on the line. If the actual relative harmonic power dissipated by the antenna (radiation plus ohmic losses) is desired, directional couplers can be used to measure both the forward and reflected waves. For best results, the coupler must have good directivity at the highest harmonic frequency. It should also have an output impedance approximately constant with frequency or small compared to 50 ohms at the highest harmonic frequency measured.

With a dummy-load termination, either a directional coupler or a small coupling loop can be used, since the reflected wave is small. The coupling loop should have a reactance that is small compared to 50 ohms. (For a rough approximation, $L = 5 \times \ell$ millimicrohenries, where ℓ is the length of the loop in centimeters.)

With either the directional coupler or coupling loop, the voltage induced with a constant magnitude of current flowing in the main line is

[3]Recommended for 3-1/8-in. line are (a) RCA MI-19396-1 UHF - VHF Directional Coupler with either MI-19396-2 UHF or MI-19396-3 VHF Coupler Housing or (b) a GE 7133080G1 Directional Coupler. For 1-5/8-in. line, a GE 7133081G1 Directional Coupler is suitable.

directly proportional to frequency. Therefore, the relative harmonic voltages developed across the detector will be n times the relative harmonic voltage in the main line where n is the harmonic number. Therefore, the second harmonic will appear 6 db too large; the third, 9 db too large; fourth, 12 db; fifth, 14 db; sixth, 15.6 db; seventh, 16.9 db; eighth, 18.1 db; ninth, 19.1 db; and tenth, 20 db too large. The measured results can easily be corrected for the coupling factor indicated above. (See Charts.)

Section 3

OPERATING PROCEDURE

3.1 INSTALLATION. Set up the equipment as shown in Figure 4, using an appropriate coupling device to the main line as outlined in paragraph 2.6. For best results, use Type 874-Y Clip Locks on all Type 874 Connectors. If possible, make a direct connection, rather than a cable, between the coupler and the measuring circuit. If a cable must be used, use a double-shielded cable, of as short a length as possible. Leakage in the cables can be a source of error when relatively small harmonics are measured.

3.2 PROCEDURE.

a. Choose the data sheet for the channel to be measured from the sheets supplied. First measure the visual carrier.

b. With the fundamental rejection filters out of the circuit, measure the relative magnitude of the fundamental by setting the local oscillator to the response nearest the frequency found in the column labeled "Set L. O.". The low-pass filter listed on the data sheet should be in the circuit for this measurement. Then adjust the coupling to the main line or add an additional 10-db pad ahead of the mixer to make the i-f amplifier read on the calibrated db portion of the scale with the attenuator set to 70 db. Do not add more than one additional 10-db pad, or else the power dissipation will be greater than 1/2 watt.

c. Throw the METER READS switch on the i-f amplifier to RECTIFIED MIXER CURRENT and adjust the output from the Type 1208 Unit Oscillator to provide a meter reading between 20 and 80 divisions. Then throw the switch to its original position and repeak the signal by adjusting the local-oscillator frequency. Make sure that the meter reading is still on the calibrated portion of the db scale with the step attenuator set at 70 db. Record the sum of the attenuator reading A_a and the meter reading A_m in the column labeled "A".

d. Insert the two appropriate Type 874-FR Rejection Filters with a Type 874-G10 Pad between them as shown in Figure 5.

e. Recheck the peaking of the local oscillator. It may be necessary to reduce the attenuation of the step attenuator in order to obtain a satisfactory meter reading. Then adjust the tuning screws on the underside of the Type 874-FR Rejection Filters alternately until the smallest possible indication on the i-f amplifier is obtained. The setting of the step attenuator should be gradually reduced during this adjustment and should be finally set between zero and 20 db when the filters are properly adjusted. Record the sum of the step attenuator and meter readings in the column labeled "A".

f. Measure the second harmonic by setting the local oscillator to the response nearest the frequency found in the "Set L. O." column opposite "2nd harmonic"[4] and adjust the step attenuator to obtain a meter reading on the calibrated db portion of the scale. If a sufficiently high reading is not obtained even with the step attenuator set at zero, remove one or more of the pads between the first rejection filter and the coupling to the transmission line. If the meter indication, with all pads ahead of the rejection filters removed, is still below the zero line on the meter, remove the pad between the second rejection filter and the mixer. Never remove the pad between the two rejection filters. Then enter the total attenuation of all pads removed in the appropriate column on the data sheet. Check the rectified mixer current, which should be between 20 and 100 divisions. Carefully peak the meter indication in the portion of the scale calibrated in db by retuning the local oscillator slightly. Record the sum of the step attenuator and meter readings in the appropriate columns.

g. Repeat the above procedure for all harmonics up to about 450 Mc, and then shift over to second-harmonic operation of the mixer if indicated on the data sheet.[5] To determine the loss in gain as a result of second-harmonic operation, measure the same harmonic on both the fundamental and second harmonic of the local oscillator as indicated. Make sure that the rectified mixer current is above 20 divisions and less than 100 divisions for these measurements. Record the difference in the sums of the step attenuator and meter readings in the column labeled "Corr. for 2nd harm. mixing", and use this figure for all other second-harmonic measurements. Also change low-pass filters at the frequencies indicated on the data sheets.

h. Add or subtract the corrections indicated and pads removed from the "A" readings on the data sheets and obtain "A_e". Then subtract the value of A_e for the fundamental without rejection filters from the value of A_e found for each of the harmonics. The result is the relative harmonic level below the fundamental for each harmonic.

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[4]In some instances it is possible to find spurious responses fairly close to the desired response. The location of these responses is indicated on the data sheet, and they can be easily identified. The use of the Type 1209 Unit Oscillator on its fundamental for channels 7 through 13 eliminates all closely spaced spurious responses.

[5]For channels 7 through 13, fundamental operation up to 890 Mc is recommended with a Type 1209 Unit Oscillator.

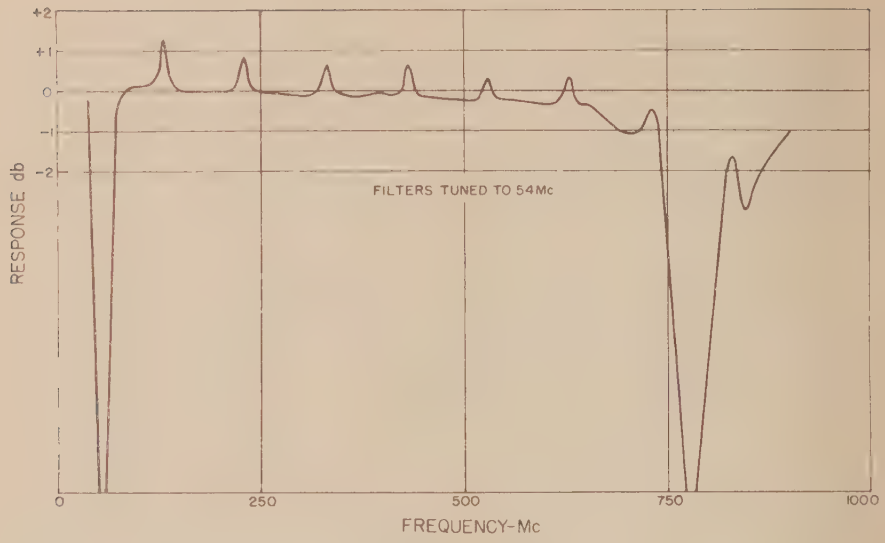


Figure 2. Frequency Response Curve
(without Type 874-F Low-Pass Filters).

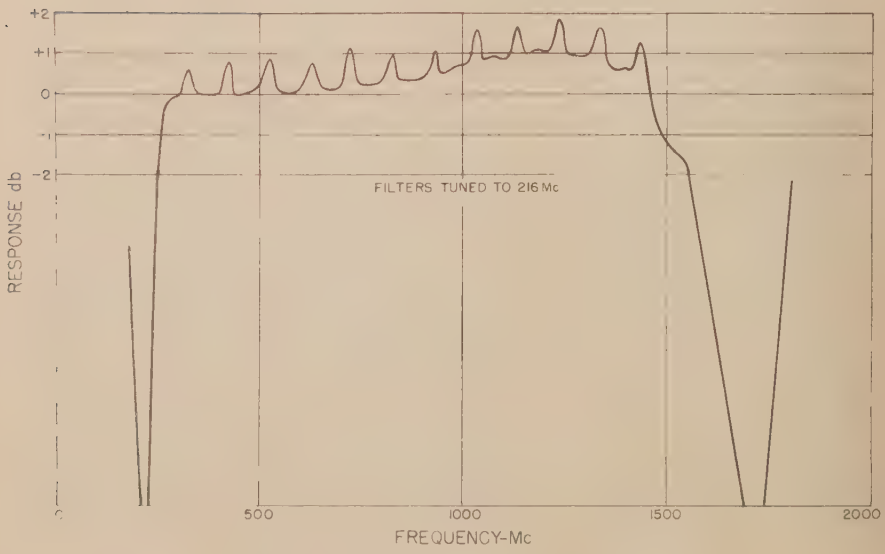


Figure 3. Frequency Response Curve
(without Type 874-F Low-Pass Filters).

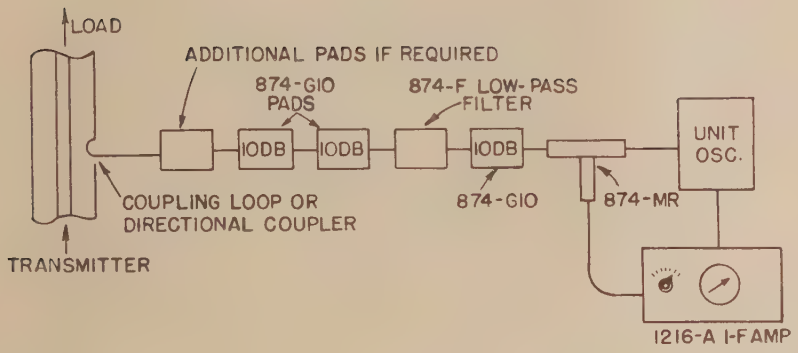


Figure 4. Setup for Measuring Relative Level of Fundamental.

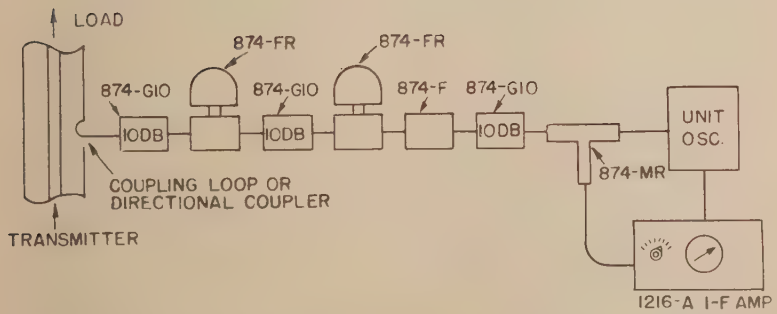


Figure 5. Setup for Measuring Relative Levels of Harmonics.

CHANNEL 2

Visual Carrier - 55.25 Mc

874-FR-1 Rejection Filter

Harmonic	Local Osc.†	Freq.	Set L.O.	Nearest Spurious Resp. - Mc	Low-Pass Filter	A ($A_a + A_m$) db	Pads Removed db	Corr. for Coupling Loop - db	Corr. for Filter db	A_e (A + Corr.) db	Harmonic Level A_e (Fund.) - A_e (Harm.)
Fund. Fil. Out	1208	55.25	85.25*		F185			0	+2		
Fund. Fil. In	1208	55.25	85.25*	-4.75	F185			0	+2		
2nd	1208	110.5	140.5*	-4.75	F185		–	-6	+3		
3rd	1208	165.75	195.75*	-4.75	F185		–	-9	+3		
4th	1209	221.0	251.0*	-4.74 +12.625	F500		–	-12	0		
5th	1209	276.25	306.25*	-4.75 +12.625	F500		–	-14	+2.5		
6th	1209	331.5	361.5*	-4.75	F500		–	-15.6	+3.5		
7th	1209	386.75	416.75*	-4.75	F500		–	-16.9	+1.5		
8th	1209	442.0	472.0*	4.75	F500		–	-18.1	+3		
9th	1209	497.25	527.25*	-4.75 +12.625	F1000		–	-19.1	+1		
10th	1209	552.5	582.5*	-4.75 +12.625	F1000		–	-20	+2.5		
Aural Carrier - 59.75 Mc											
Fund. Fil. Out	1208	59.75	89.75*		F185			0	+2		
Fund. Fil. In	1208	59.75	89.75*	-0.25	F185			0	+2		
2nd	1208	119.5	149.5*	-0.25	F185		–	-6	+3		
3rd	1208	179.25	209.25*	-0.25	F500		–	-9	+3		
4th	1209	239.0	269.0*	-0.25 +15	F500		–	-12	+1		
5th	1209	298.75	328.75*	-0.25	F500		–	-14	+3		
6th	1209	358.5	388.5*	-0.25	F500		–	-15.6	+3		
7th	1209	418.25	448.25*	-0.25	F500		–	-16.9	+1		
8th	1209	478.0	508.0*	-0.25, +15	F1000		–	-18.1	+1		
9th	1209	537.75	567.75*	-0.25, +15	F1000		–	-19.1	+2.5		
10th	1209	597.5	627.5*	-0.25, +15	F1000		–	-20	+3.5		

* A small spurious response may be found 0.25 Mc below the true local oscillator frequency in the case of the aural carrier, and 4.75 Mc below the true local oscillator frequency in the case of the visual carrier. Set the local oscillator to the higher of the two responses if they are found. The lower response is actually the image of the adjacent harmonic of the signal.

† Wherever the Type 1208 Unit Oscillator is specified, the Type 1215 can be used in its place.

CHANNEL 3

Visual Carrier - 61.25 Mc

874-FR-1 Rejection Filter

Harmonic	Local Osc.†	Freq.	Set L.O.	Nearest Spurious Resp. -Mc	Low-Pass Filter	A ($A_a + A_m$) db	Pads Removed db	Corr. for Coupling Loop - db	Corr. for Filter db	A_e (A + Corr.) db	Harmonic Level A_e (Fund.) - A_e (Harm.)
Fund. Fil. Out	1208	61.25	91.25*		F185			0	+1		
Fund. Fil. In	1208	61.25	91.25*	+1.25	F185			0	+1		
2nd	1208	122.5	152.5*	+1.25	F185		–	-6	+3		
3rd	1208	183.75	213.75*	+1.25	F500		–	-9			
4th	1209	245.0	275.0*	+1.25	F500		–	-12			
5th	1209	306.25	336.25*	+1.25, ±15	F500		–	-14			
6th	1209	367.5	397.5*	+1.25, ±15	F500		–	-15.6			
7th	1209	428.75	458.75*	+1.25	F500		–	-16.9			
8th	1209	490.0	520.0*	+1.25, ±15	F1000		–	-18.1	+1		
9th	1209	551.25	581.25*	+1.25, ±15	F1000		–	-19.1	+2.5		
10th	1209	612.5	642.5*	+1.25, ±15	F1000		–	-20	+3.5		

*A small spurious response may be found 1.25 Mc above the true local oscillator frequency. Set the local oscillator to the lower of the two responses if they are found. The higher response is actually the image of the adjacent harmonic of the signal.

Aural Carrier - 65.75 Mc

Fund. Fil. Out	1208	65.75	95.75*		F185			0	+1		
Fund. Fil. In	1208	65.75	95.75*	+5.75, +1.9	F185			0	+1		
2nd	1208	131.5	161.5*	+5.75	F185		–	-6	+2		
3rd	1208	197.25	227.25*	+5.75, -12, +1.9	F500		–	-9			
4th	1209	263.0	293.0*	+5.75, -12	F500		–	-12			
5th	1209	328.75	358.75*	+5.75	F500		–	-14			
6th	1209	394.5	424.5*	+5.75	F500		–	-15.6			
7th	1209	460.25	490.25*	+5.75	F1000		–	-16.9	0		
8th	1209	526.0	556.0*	+5.75, -12	F1000		–	-18.1	+2		
9th	1209	591.75	621.75*	+5.75, -12	F1000		–	-19.1	+3		
10th	1209	657.5	687.5*	+5.75, -12	F1000		–	-20	+3.5		

*A small spurious response may be found 5.75 Mc (1.92 Mc also for fund. and 3rd harmonic) above the true local oscillator frequency. Set the local oscillator to the lower of the two responses if found. The higher response is actually the image of the adjacent harmonic of the signal.

† Wherever the Type 1208 Unit Oscillator is specified, the Type 1215 can be used in its place.

CHANNEL 4

Visual Carrier - 67.25 Mc

874-FR-1 Rejection Filter

Harmonic	Local Osc.†	Freq.	Set L.O.	Nearest Spurious Resp. -Mc	Low-Pass Filter	A (A_a+A_m) db	Pads Removed db	Corr. for Coupling Loop-db	Corr. for Filter db	A_e (A+Corr.) db	Harmonic Level A_e (Fund.) $-A_e$ (Harm.)
Fund. Fil. Out	1208	67.25	97.25		F185			0	+1		
Fund. Fil. In	1208	67.25	97.25	+7.25, -11.4	F185			0	+1		
2nd	1208	134.5	164.5	+7.25	F185		-	-6	+2		
3rd	1208	201.75	231.75	+7.25, -11.4	F500		-	-9	+1		
4th	1209	269.0	299.0	+7.25, -11.4	F500		-	-12	+2.5		
5th	1209	336.25	366.25	+7.25	F500		-	-14	+3.5		
6th	1209	403.5	433.5	+7.25	F500		-	-15.6	0		
7th	1209	470.75	500.75	+7.25	F1000		-	-16.9	+0.5		
8th	1209	538.0	568.0	+7.25, -11.4	F1000		-	-18.1	+2.5		
9th	1209	605.25	635.25	+7.25, -11.4	F1000		-	-19.1	+3.5		
10th	1209	672.5	702.5	+7.25	F1000		-	-20	+3.5		
Aural Carrier - 71.75 Mc											
Fund. Fil. Out	1208	71.75	101.75		F185			0	0		
Fund. Fil. In	1208	71.75	101.75	+11.75, -9.12	F185			0	0		
2nd	1208	143.5	173.5	+11.75	F185		-	-6	0		
3rd	1208	215.25	245.25	+11.75, -9.12	F500		-	-9	+0.5		
4th	1209	287.0	317.0	+11.75	F500		-	-12	+3		
5th	1209	358.75	388.75	+11.75	F500		-	-14	+3		
6th	1209	430.5	460.5	+11.75	F500		-	-15.6	+2		
7th	1209	502.25	532.25	+11.75, -9.12	F1000		-	-16.9	+1.5		
8th	1209	574.0	604.0	+11.75, -9.12	F1000		-	-18.1	+2.5		
9th	1209	645.75	675.75	+11.75, -9.12	F1000		-	-19.1	+3.5		
10th	1209	717.5	747.5	+11.75	F1000		-	-20	+3		

† Wherever the Type 1208 Unit Oscillator is specified, the Type 1215 can be used in its place.

Visual Carrier - 77.25 Mc

874-FR-2 Rejection Filter

Harmonic	Local Osc.†	Freq.	Set L.O.	Nearest Spurious Resp. -Mc	Low-Pass Filter	A (A_a+A_m) db	Pads Removed db	Corr. for Coupling Loop -db	Corr. for Filter db	A_e (A+Corr.) db	Harmonic Level A_e (Fund.) -A_e (Harm.)
Fund. Fil. Out	1208	77.25	107.25		F185			0	0		
Fund. Fil. In	1208	77.25	107.25	-6.4, +17.25	F185			0	0		
2nd	1208	154.5	184.5	+17.25	F185		-	-6	+2		
3rd	1209	231.75	261.75*	-6.4, +17.25	F500		-	-9	0		
4th	1209	309.0	339.0	+17.25	F500		-	-12	+3.5		
5th	1209	386.25	416.25	+17.25	F500		-	-14	+1.5		
6th	1209	463.5	493.5	+17.25	F1000		-	-15.6	0		
7th	1209	540.75	570.75*	-6.4, +17.25	F1000		-	-16.9	+2.5		
8th	1209	618.0	648.0*	-6.4, +17.25	F1000		-	-18.1	+3.5		
9th	1209	695.25	725.25	+17.25	F1000		-	-19.1	+3.0		
10th	1209	772.5	802.5	+17.25	F1000		-	-20	+1.5		

*A small spurious response may be found 6.4 Mc below the true local oscillator frequency. Set the local oscillator to the higher of the two close responses.

Aural Carrier - 81.75 Mc

Fund. Fil. Out	1208	81.75	111.75		F185			0	0		
Fund. Fil. In	1208	81.75	111.75	-4.1, -15, +21.75	F185			0	0		
2nd	1208	163.5	193.5	+21.75	F185		-	-6	+3		
3rd	1209	245.25	275.25*	-4.1, -15, +21.75	F500		-	-9	+1.5		
4th	1209	327.0	357.0	+21.75	F500		-	-12	+3.5		
5th	1209	408.75	438.75	+21.75	F500		-	-14	0		
6th	1209	490.5	520.5*	-4.1, -15, +21.75	F1000		-	-15.6	+1		
7th	1209	572.25	602.25*	-4.1, -15, +21.75	F1000		-	-16.9	+3		
8th	1209	654.0	684.0*	-4.1, -15, +21.75	F1000		-	-18.1	+3.5		
9th	1209	735.75	765.75	+21.75	F1000		-	-19.1	+2.5		
10th	1209	817.5	847.5	+21.75	F1000		-	-20	+0.5		

*A small spurious response may be found 4.1 Mc below the true local oscillator frequency. Set the local oscillator to the higher of the two close responses.

† Wherever the Type 1208 Unit Oscillator is specified, the Type 1215 can be used in its place.

CHANNEL 6

Visual Carrier - 83.25 Mc

874-FR-2 Rejection Filter

Harmonic	Local Osc.†	Freq.	Set L.O.	Nearest Spurious Resp. -Mc	Low-Pass Filter	A (A_a+A_m) db	Pads Removed db	Corr. for Coupling Loop-db	Corr. for Filter db	A_e (A+Corr.) db	Harmonic Level A_e (Fund.) $-A_e$ (Harm.)
Fund. Fil. Out	1208	83.25	113.25		F185			0	0		
Fund. Fil. In	1208	83.25	113.25	-15,+23.25	F185			0	0		
2nd	1208	166.5	196.5	+23.25	F185		-	-6	+3		
3rd	1209	249.75	279.75*	-3.4, -15, +23.25	F500		-	-9	+1.5		
4th	1209	333.0	363.0	+23.25	F500		-	-12	+3.5		
5th	1209	416.25	446.25	+23.25	F500		-	-14	+1		
6th	1209	499.5	529.5*	-3.4, -15, +23.25	F1000		-	-15.6	+1.5		
7th	1209	582.75	612.75*	-3.4, -15, +23.25	F1000		-	-16.9	+3		
8th	1209	666.0	696.0*	-3.4, -15, +23.25	F1000		-	-18.1	+3.5		
9th	1209	749.25	779.25	+23.25	F1000		-	-19.1	+2.5		
10th	1209	832.5	862.5	+23.25	F1000		-	-20	+0.5		
Aural Carrier - 87.75 Mc											
Fund. Fil. Out	1208	87.75	117.75		F185			0	+1		
Fund. Fil. In	1208	87.75	117.75	-15,+27.25	F185			0	+1		
2nd	1208	175.5	205.5	+27.25	F185		-	-6	+3		
3rd	1209	263.25	293.25*	-1.1, -15, +27.25	F500		-	-9	+2		
4th	1209	351.0	381.0	+27.25	F500		-	-12	+3		
5th	1209	438.75	468.75	+27.25	F500		-	-14	+2.5		
6th	1209	526.5	556.5*	-1.1, -15, +27.25	F1000		-	-15.6	+2		
7th	1209	614.25	644.25*	-1.1, -15, +27.25	F1000		-	-16.9	+3.5		
8th	1209	702.0	732.0*	-1.1, -15, +27.25	F1000		-	-18.1	+3		
9th	1209	789.75	819.75	+27.25	F1000		-	-19.1	+1		
10th	1209	877.5	907.5	+27.25	F1000		-	-20	+2.5		

*A small spurious response may be found slightly below the true local oscillator frequency. Set the local oscillator to the higher of the two very close responses.

†Wherever the Type 1208 Unit Oscillator is specified, the Type 1215 can be used in its place.

CHANNEL 7

Visual Carrier - 175.25 Mc

Types 1208 Unit Oscillator and 874-FR-3 Rejection Filter

Harmonic	Freq.	Set L.O.[1]	Nearest Spurious Resp. -Mc	Low-Pass Filter	A ($A_a + A_m$) db	Pads Removed db	Corr. for Coupling Loop-db	Corr. for 2nd Harm. Mixing -db	Corr. for Filter db	A_e (A+Corr.) db	Harmonic Level A_e (Fund.) -A_e (Harm.)
Fund. Fil. Out	175.25	205.25		F500			0		+2		
Fund. Fil. In	175.25	205.25		F500			0		+2		
2nd	350.5	380.5		F500		-	-6		+3		
		190.25**	-5, +15	F500		XXX	XXX		XXX	XXX	XXX
3rd	525.75	277.875*	+4.2	F1000		-	-9	+	+2		
4th	701	365.5**	-5, +15	F1000		-	-12	+	+3		
5th	876.25	453.125		F1000		-	-14	+	+2.5		
Aural Carrier - 179.75 Mc											
Fund. Fil. Out	179.75	209.75		F500			0		+2		
Fund. Fil. In	179.75	209.75		F500			0		+2		
2nd	359.5	389.5		F500		-	-6		+3		
		194.75**	-5, +15	F500		XXX	XXX		XXX	XXX	XXX
3rd	539.25	284.62*	+5	F1000		-	-9	+	+2.5		
4th	719	374.5**	-5, +15	F1000		-	-12	+	+3		
5th	898.75	464.87		F1000		-	-14	+	+3		

*At these frequencies, the nearest spurious response can be reasonably close to the desired response as indicated. Set the local oscillator to the lower response.

**At these frequencies, the nearest spurious response can be reasonably close to the desired response as indicated. Set the local oscillator to the higher response.

[1]If a Type 1209 Unit Oscillator is used as a local oscillator at signal harmonics above 250 Mc (in which case the mixer can be operated on the fundamental of the local oscillator), the nearest possible spurious response is at least 15 Mc from the true response. In this type of operation, set the local oscillator frequency 30 Mc above the signal harmonic frequency. Use 2nd-harmonic operation if the desired frequency is above the range of the oscillator.

CHANNEL 8

Visual Carrier - 181.25 Mc

Types 1208 Unit Oscillator and 874-FR-3 Rejection Filter

Harmonic	Freq.	Set L.O.[1]	Nearest Spurious Resp. -Mc	Low-Pass Filter	A ($A_s + A_m$) db	Pads Removed db	Corr. for Coupling Loop-db	Corr. for 2nd Harm. Mixing-db	Corr. for Filter db	A_e (A+Corr.) db	Harmonic Level A_e (Fund.) - A_e (Harm.)
Fund. Fil. Out	181.25	211.25		F500			0		+2		
Fund. Fil. In	181.25	211.25		F500			0		+2		
2nd	362.5	392.5		F500		-	-6		+3		
		196.25**	-5, +15	F500		XXX	XXX		XXX	XXX	XXX
3rd	543.75	286.875*	+5.3	F1000		-	-9	+	+2.5		
4th	725	377.5**	-5, +15	F1000		-	-12	+	+3		
5th	906.25	468.125		F1000		-	-14	+	+3		
Aural Carrier - 185.75 Mc											
Fund. Fil. Out	185.75	215.75		F500			0		+2		
Fund. Fil. In	185.75	215.75		F500			0		+2		
2nd	371.5	401.5		F500		-	-6		+2.5		
		200.75**	-5, +15	F500		XXX	XXX		XXX	XXX	XXX
3rd	557.25	293.62*	+6, -15	F1000		-	-9	+	+2.5		
4th	743	386.5	-5, +15	F1000		-	-12	+	+2.5		
5th	928.75	479.37		F1000		-	-14	+	+3.5		

*At these frequencies, the nearest spurious response can be reasonably close to the desired response as indicated. Set the local oscillator to the lower response.

**At these frequencies, the nearest spurious response can be reasonably close to the desired response as indicated. Set the local oscillator to the higher response.

[1]If a Type 1209 Unit Oscillator is used as a local oscillator at signal harmonics above 250 Mc (in which case the mixer can be operated on the fundamental of the local oscillator), the nearest possible spurious response is at least 15 Mc from the true response. In this type of operation, set the local oscillator frequency 30 Mc above the signal harmonic frequency. Use 2nd-harmonic operation if the desired frequency is above the range of the oscillator.

CHANNEL 9

Visual Carrier - 187.25 Mc

Types 1208 Unit Oscillator and 874-FR-3 Rejection Filter

Harmonic	Freq.	Set L.O.[1]	Nearest Spurious Resp. -Mc	Low-Pass Filter	A ($A_a + A_m$) db	Pads Removed db	Corr. for Coupling Loop-db	Corr. for 2nd Harm. Mixing-db	Corr. for Filter db	A_e (A+Corr.) db	Harmonic Level A_e (Fund.) $-A_e$ (Harm.)
Fund. Fil. Out	187.25	217.25		F500			0		+2		
Fund. Fil. In	187.25	217.25		F500			0		+2		
2nd	374.5	404.5		F500		-	-6		+2		
		202.25*	-5, +15	F500		XXX	XXX		XXX	XXX	XXX
3rd	561.75	295.875	-7.5, +6.2	F1000		-	-9	+	+3		
4th	749	389.5*	-5, +15	F1000		-	-12	+	+2.5		
5th	936.25	483.125		F1000		-	-14	+	+3.5		
Aural Carrier - 191.75 Mc											
Fund. Fil. Out	191.75	221.75		F500			0		+1.5		
Fund. Fil. In	191.75	221.75		F500			0		+1.5		
2nd	383.5	413.5		F500		-	-6		+1.5		
		206.75*	-5, +15	F500		XXX	XXX		XXX	XXX	XXX
3rd	575.25	302.625	-7.5, +7	F1000		-	-9	+	+3		
4th	767	398.5*	-5, +15	F1000		-	-12	+	+2		
5th	958.75	494.375		F1000		-	-14	+	+3.5		

*At these frequencies, the nearest possible spurious response is reasonably close to the desired response. Set the local oscillator to the higher response.

[1]If a Type 1209 Unit Oscillator is used as a local oscillator at signal harmonics above 250 Mc (in which case the mixer can be operated on the fundamental of the local oscillator), the nearest possible spurious response is at least 15 Mc from the true response. In this type of operation, set the local oscillator frequency 30 Mc above the signal harmonic frequency. Use 2nd-harmonic operation if the desired frequency is above the range of the oscillator.

CHANNEL 10

Visual Carrier - 193.25 Mc

Types 1208 Unit Oscillator and 874-FR-3 Rejection Filter

Harmonic	Freq.	Set L.O.[1]	Nearest Spurious Resp. -Mc	Low-Pass Filter	A (A_a+A_m) db	Pads Removed db	Corr. for Coupling Loop -db	Corr. for 2nd Harm. Mixing -db	Corr. for Filter db	A_e (A+Corr.) db	Harmonic Level A_e (Fund.) -A_e (Harm.)
Fund. Fil. Out	193.25	223.25		F500			0		+1.5		
Fund. Fil. In	193.25	223.25		F500			0		+1.5		
2nd	386.5	416.5		F500		-	-6		+1.5		
		208.25*	-5, +15	F500		XXX	XXX		XXX	XXX	XXX
3rd	579.75	304.875	-7.5, +7	F1000		-	-9	+	+3		
4th	773	401.5*	-5, +15	F1000		-	-12	+	+1.5		
5th	966.25	498.125		F1000		-	-14	+	+3		
Aural Carrier - 197.75 Mc											
Fund. Fil. Out	197.75	227.75		F500			0		+1.5		
Fund. Fil. In	197.75	227.75		F500			0		+1.5		
2nd	395.5	425.5		F500		-	-6		+0.5		
		212.75*	-5, +15	F500		XXX	XXX		XXX	XXX	XXX
3rd	593.25	311.625	-7.5, +8	F1000		-	-9	+	+3		
4th	791	410.5*	-5. +15	F1000		-	-12	+	+1		
5th	988.75	479.375		F1000		-	-14	+	+3		

*At these frequencies, the nearest possible spurious response is reasonably close to the desired response. Set the local oscillator to the higher response.

[1]If a Type 1209 Unit Oscillator is used as a local oscillator at signal harmonics above 250 Mc (in which case the mixer can be operated on the fundamental of the local oscillator), the nearest possible spurious response is at least 15 Mc from the true response. In this type of operation, set the local oscillator frquency 30 Mc above the signal harmonic frequency. Use 2nd-harmonic operation if the desired frequency is above the range of the oscillator.

CHANNEL 11

Visual Carrier - 199.25 Mc

Types 1208 Unit Oscillator and 874-FR-3 Rejection Filter

Harmonic	Freq.	Set L.O.[1]	Nearest Spurious Resp. -Mc	Low-Pass Filter	A ($A_a + A_m$) db	Pads Removed db	Corr. for Coupling Loop -db	Corr. for 2nd Harm. Mixing -db	Corr. for Filter db	A_e (A+Corr.) db	Harmonic Level A_e (Fund.) - A_e (Harm.)
Fund. Fil. Out	199.25	229.25		F500			0		+1		
Fund. Fil. In	199.25	229.25		F500			0		+1		
2nd	398.5	428.5		F500		-	-6		0		
		214.25*	-5, +15	F500		XXX	XXX		XXX	XXX	XXX
3rd	597.75	313.875	-7.5, +8	F1000		-	-9	+	+3		
4th	797	413.5*	-5. +15	F1000		-	-12	+	+0.5		
5th	996.25	483.125		F1000		-	-14	+	+3		
Aural Carrier - 203.75											
Fund. Fil. Out	203.75	233.75		F500			0		+1		
Fund Fil. In	203.75	233.75		F500			0		+1		
2nd	407.5	437.5		F500		-	-6		0		
		218.75*	-5, +15	F500		XXX	XXX		XXX	XXX	XXX
3rd	611.25	320.625	-7.5, +9	F1000		-	-9	+	+3.5		
4th	815	422.5*	-5. +15	F1000		-	-12	+	0		

*At these frequencies, the nearest spurious response can be reasonably close to the desired response as indicated. Set the local oscillator to the higher response.

[1]If a Type 1209 Unit Oscillator is used as a local oscillator at signal harmonics above 250 Mc (in which case the mixer can be operated on the fundamental of the local oscillator), the nearest possible spurious response is at least 15 Mc from the true response. In this type of operation, set the local oscillator frequency 30 Mc above the signal harmonic frequency. Use 2nd-harmonic operation if the desired frequency is above the range of the oscillator.

CHANNEL 12

Visual Carrier - 205.25 Mc

Types 1208 Unit Oscillator and 874-FR-3 Rejection Filter

Harmonic	Freq.	Set L.O.[1]	Nearest Spurious Resp. -Mc	Low-Pass Filter	A ($A_a + A_m$) db	Pads Removed db	Corr. for Coupling Loop -db	Corr. for 2nd Harm. Mixing-db	Corr. for Filter db	A_e (A+Corr.) db	Harmonic Level A_e (Fund.) -A_e (Harm.)
Fund. Fil. Out	205.25	235.25		F500			0		+1		
Fund. Fil. In	205.25	235.25		F500			0		+1		
2nd	410.5	440.5		F500		-	-6		0		
		220.25*	-5, +15	F500		XXX	XXX		XXX	XXX	XXX
3rd	615.75	322.875	-7.5, +9	F1000		-	-9	+	+3.5		
4th	821	425.5*	-5, +15	F1000		-	-12	+	+0.5		
Aural Carrier - 209.75 Mc											
Fund. Fil. Out	209.75	239.75		F500			0		+0.5		
Fund. Fil. In	209.75	239.75		F500			0		+0.5		
2nd	419.5	449.5		F500		-	-6		+1		
		224.75*	-5, +15	F500		XXX	XXX		XXX	XXX	XXX
3rd	629.25	329.625	-7.5, +10	F1000		-	-9	+	+3.5		
4th	839	434.5*	-5, +15	F1000		-	-12	+	+1.0		

*At these frequencies, the nearest spurious response can be reasonably close to the desired response as indicated. Set the local oscillator to the higher response.

[1]If a Type 1209 Unit Oscillator is used as a local oscillator at signal harmonics above 250 Mc (in which case the mixer can be operated on the fundamental of the local oscillator), the nearest possible spurious response is at least 15 Mc from the true response. In this type of operation, set the local oscillator frequency 30 Mc above the signal harmonic frequency. Use 2nd-harmonic operation if the desired frequency is above the range of the oscillator.

CHANNEL 13

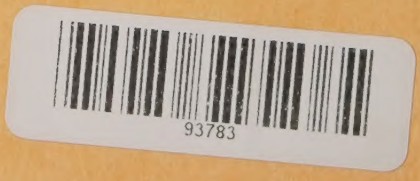
Types 1208 Unit Oscillator and 874-FR-3 Rejection Filter

Visual Carrier - 211.25 Mc

Harmonic	Freq.	Set L.O.[1]	Nearest Spurious Resp. -Mc	Low-Pass Filter	A (A_a+A_m) db	Pads Removed db	Corr. for Coupling Loop -db	Corr. for 2nd Harm. Mixing-db	Corr. for Filter db	A_e (A+Corr.) db	Harmonic Level A_e (Fund.) -A_e (Harm.)
Fund. Fil. Out	211.25	241.25		F500			0		+0.5		
Fund. Fil. In	211.25	241.25		F500			0		+0.5		
2nd	422.5	452.5		F500		-	-6		+1.5		
		226.25*	-5, +15	F500		XXX	XXX		XXX	XXX	XXX
3rd	633.75	331.875	-7.5, +10	F1000		-	-9	+	+3.5		
4th	845	437.5*	-5, +15	F1000		-	-12	+	+1.5		
Aural Carrier - 215.75 Mc											
Fund. Fil. Out	215.75	245.25		F500			0		+0.5		
Fund. Fil. In	215.75	245.25		F500			0		+0.5		
2nd	431.5	461.5		F500		-	-6		+2		
		230.75*	-5, +15	F500		XXX	XXX		XXX	XXX	XXX
3rd	647.25	338.625	-7.5, +11	F1000		-	-9	+	+3.5		
4th	863	446.5*	-5, +15	F1000		-	-12	+	+2		

*At these frequencies, the nearest spurious response can be reasonably close to the desired response as indicated. Set the local oscillator to the higher response.

[1]If a Type 1209 Unit Oscillator is used as a local oscillator at signal harmonics above 250 Mc (in which case the mixer can be operated on the fundamental of the local oscillator), the nearest possible spurious response is at least 15 Mc from the true response. In this type of operation, set the local oscillator frequency 30 Mc above the signal harmonic frequency. Use 2nd-harmonic operation if the desired frequency is above the range of the oscillator.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